when you call (in your home area, in extended home areas, in a variety of "roaming" areas away from your home base), and where you're calling to (across town, outside your home zone, in-state, across the country).

Sales representatives often try to help shoppers choose a plan by asking "Where will you be using your phone most of the time?" or "How long will your calls be?" But because the very reason for having a cell phone in the first place is to give you a way to communicate at times that are inherently unpredictable, such questions can be answered only in the most general way.

Finding the best deal

We gathered data on some 200 plans available in the nation's top 20 markets. Our aim was to find the most economical plan offered by each wireless service provider in each market —whether cellular or PCS. (For a description of how they differ, see below.) Each of the 14 companies whose plans we scrutinized hold operating licenses and own transmission equipment in several markets, with one exception: MCI, the long-distance phone company, purchases access time from other companies and resells it. Together, the companies we surveyed serve more than 25 million customers and dominate nearly 70 percent of the market.

The Cellular family finds a new way to stay in touch Soon after the year 2000, industry experts predict, Mom, Dad, and the kids will each have a personal cell phone.

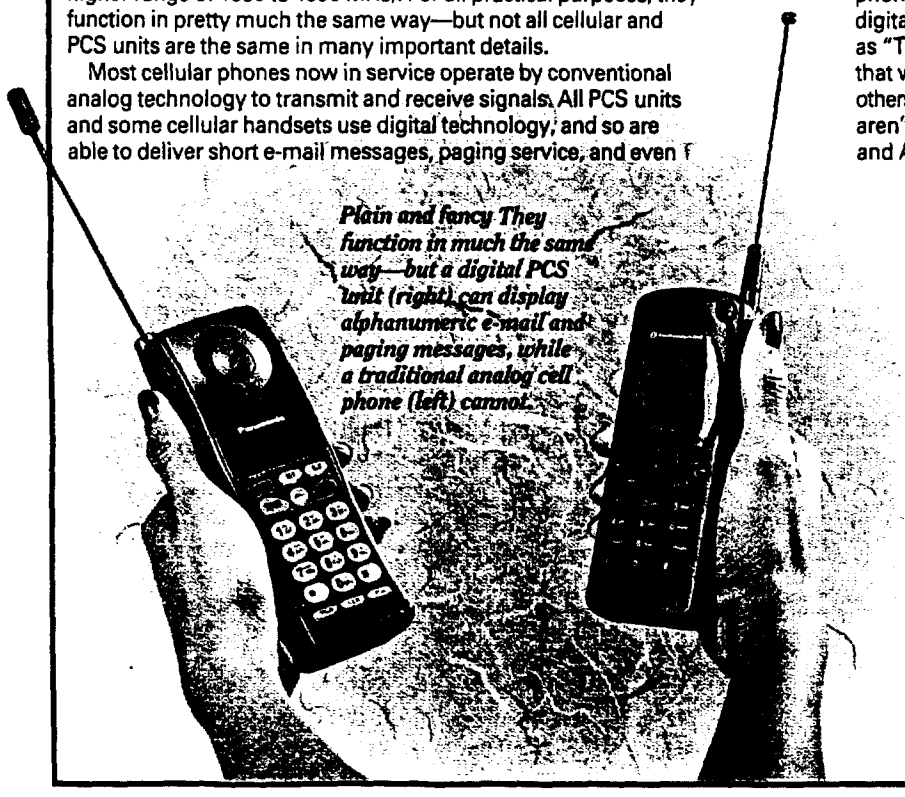
By itself, none of the pricing information described in the plans—per-minute charges, roaming rates, monthly access fees—says much about the ultimate cost to consumers. These numbers reveal their true wallet impact only when they're applied to actual usage patterns. So we plugged the price details into the real-world behavior of the average subscriber currently buying cell-phone service for personal, not business, use. According to the MTA-EMCI consulting firm, that typical customer is billed for 42 minutes of calls per month—17 of them during peak hours, 23 off-peak, and a scant two minutes while roaming (calling from outside of the home area).

Our analysis focuses on the total monthly cost of calling, because that is the greatest unknown in the purchase equation. We applied monthly access and per-minute fees to our model customer's bill, making sure to give credit for any minutes of calling time that may be included as part of a plan. We also added in any sneaky surcharges—such as an insidious $4.95 "roaming administration fee" Southwestern Bell slaps on its St. Louis-area customers any month they use roaming services. Temporary promotions were not factored in because of their fleeting nature; and supplemental

Cellular phones vs. PCS

They're called cellular "phones," but in fact they are two-way radios operating at frequencies between 824 and 894 Megahertz (MHz). Now, there is a rival technology called Personal Communications Service (PCS), recently approved by the Federal Communications Commission. PCS units look like cell phones, and they, too, send and receive radio-band signals (though at the higher range of 1850 to 1990 MHz). For all practical purposes, they function in pretty much the same way—but not all cellular and PCS units are the same in many important details.

Most cellular phones now in service operate by conventional analog technology to transmit and receive signals. All PCS units and some cellular handsets use digital technology, and so are able to deliver short e-mail messages, paging service, and even f



Plain and fancy They function in much the same way—but a digital PCS unit (right) can display alphanumeric e-mail and paging messages, while a traditional analog cell phone (left) cannot.

headline news items. But these extra features won't work if you're travelling outside of a digital network service area; you'll be able to make and receive non-digital phone calls only if your handset is equipped to function both in a digital or an analog mode.

Before you buy the technical virtuosity of PCS or digital cellular, you have to ask questions. Begin by investigating where your phone will and will not work. There are three distinct digital wireless technologies (known in the industry as "TDMA," "CDMA," and "GSM"), and equipment that works on one technology doesn't work on the others. Thus, PCS units that operate on Sprint's network aren't compatible with those on AT&T Wireless', and AT&T Wireless' won't work on PrimeCo's net.

Moreover, not all of the networks permit nationwide digital calling. The AT&T Wireless and Southwestern Bell TDMA networks are largely in place, though digital subscribers can't yet receive e-mail or pages from every location. Sprint won't launch its $3-billion system nationally until later this year, and a national GSM network won't be fully in place until around 2005.

As the networks develop, the distinction between "PCS" and "cellular" should eventually disappear. Meanwhile, the emergence of PCS is bringing welcome new competition to mobile telephony—as many as four new service providers to markets that Federal law had previously limited to just two cellular licensees. That opening up of competition accounts for the recent sharp drop in rates for both traditional cellular and PCS services. Forecasters project that as rivalry continues to heat up, prices will fall by 25 percent over the coming five years.

charges for such add-on features as voice-activated dialing, voice mail, roadside assistance, and paging were not weighed, because, industry sources say, most customers don't use them.

Our calculations disclosed which was the least expensive plan offered by each company serving the typical subscriber in the metro regions. We then ranked the plans by total monthly cost from most economical to most expensive. (See "The price of cellular service, city by city," page 15.)

The results are revealing. Prices for the least costly plans range from a low of $23.75 per month offered by the Sprint Spectrum Talk 15 plan in Baltimore/Washington, D.C. to a high of $60.19 for the MCI One plan in Los Angeles. Ameritech and AT&T Wireless emerge as the companies offering the greatest number of best deals, each topping the list in four of the markets. They are closely followed by AirTouch, the leader in three others. MCI turned out to be the highest-cost provider in 17 of the 18 listed markets where it operates.

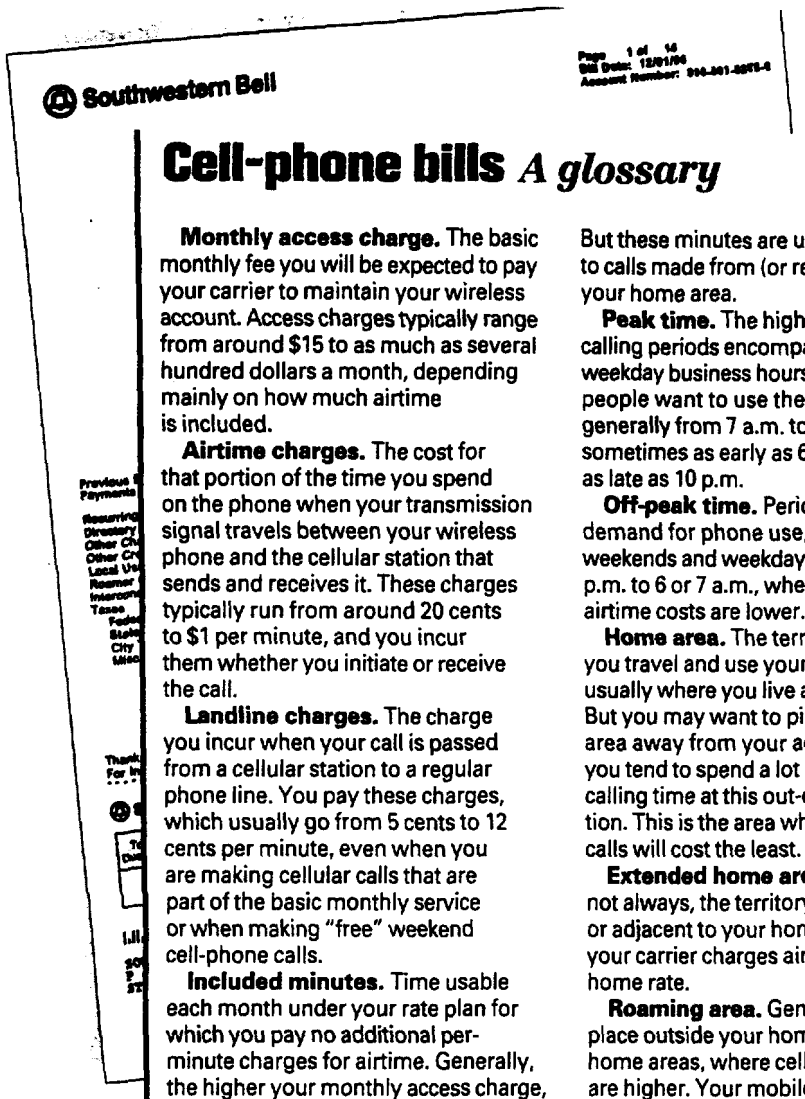
Within each market, there's a wide gap between the lowest and highest cost plans we analyzed; choosing the cheapest one can save you anywhere from 15 to 50 percent. Indeed, based on these calculations, our model customer could save $36 to $287 per year among the best plans offered by different companies in the same city.

Recommendations

If you're thinking of signing up for cellular service, take time to work out carefully how big your monthly bill is likely to be. Check, too, to see that the plan you are considering includes service in the areas where you travel most frequently at its lowest-cost "home area" rates. (See "Cell-phone bills: A glossary," on the next page.)

If possible, begin by trying out a plan that doesn't require you to commit to a long-term contract and has no early termination penalty, so you can cancel if you decide the service doesn't suit your needs. Once you've made your choice of provider, monitor closely how you use the service. Some other important considerations to keep in mind:

- **Watch out for "freebies."** Offers of an introductory allowance of "free" minutes of airtime when you sign up can be enticing to new cellular subscribers, but treat them warily. The



Cell-phone bills *A glossary*

Monthly access charge. The basic monthly fee you will be expected to pay your carrier to maintain your wireless account. Access charges typically range from around $15 to as much as several hundred dollars a month, depending mainly on how much airtime is included.

Airtime charges. The cost for that portion of the time you spend on the phone when your transmission signal travels between your wireless phone and the cellular station that sends and receives it. These charges typically run from around 20 cents to $1 per minute, and you incur them whether you initiate or receive the call.

Landline charges. The charge you incur when your call is passed from a cellular station to a regular phone line. You pay these charges, which usually go from 5 cents to 12 cents per minute, even when you are making cellular calls that are part of the basic monthly service or when making "free" weekend cell-phone calls.

Included minutes. Time usable each month under your rate plan for which you pay no additional per-minute charges for airtime. Generally, the higher your monthly access charge, the more included minutes you get. But these minutes are usually limited to calls made from (or received) within your home area.

Peak time. The higher-priced calling periods encompassing weekday business hours when most people want to use the phone, generally from 7 a.m. to 9 p.m., but sometimes as early as 6 a.m. and as late as 10 p.m.

Off-peak time. Periods of slack demand for phone use, including weekends and weekdays from 9 or 10 p.m. to 6 or 7 a.m., when per minute airtime costs are lower.

Home area. The territory where you travel and use your phone most, usually where you live and/or work. But you may want to pick a "home" area away from your actual home, if you tend to spend a lot of travel and calling time at this out-of-town location. This is the area where your cell calls will cost the least.

Extended home area. Usually, but not always, the territory surrounding or adjacent to your home area where your carrier charges airtime at your home rate.

Roaming area. Generally every place outside your home or extended home areas, where cell-phone rates are higher. Your mobile phone will indicate when you are roaming.

service providers design these incentives to get you to commit to contracts that you cannot easily terminate without having to pay supplemental fees.

An allowance of included "free" minutes may lull you into the habit of using your cell phone to make many more calls than you originally may have intended. Be sure to look into how much those "free" minutes will cost.

• **Choose the right handset.** Most cellular plans include a choice of cell-phone equipment as part of the service package. If you're interested in just making and receiving calls, these basic models will do the job. You can spend more—potentially more than $1000—for phones that weigh less, have slim profiles that fit neatly into a pocket, or come with longer-lasting batteries. Before you shell out extra for a phone, however, keep in mind that if you opt to switch carriers, the phone you buy may not work on the new provider's network. (We will test and report on cell-phone handsets later this year.)

• **Be realistic about how you'll use it.** First-time subscribers looking for safety are often directed to plans with the lowest monthly access fees, which generally run from $14.99 to $19.99. The convenience of having a cell phone, however, may make you use it more often. A low-fee plan can make sense—but only if you use the phone just in emergencies. For the average user, these plans are not always the best choice. In Detroit, for example, Ameritech Cellular Service's Safety Pack II plan charges a monthly access fee of $15.95, but users of that plan pay for all calls. By choosing the Convenience Pack plan, instead, which includes 30 minutes of calls with the $23.95 monthly charge, our average user would save $60 a year.

• **Think before you dial.** How many $1-a-minute cellular calls must you make from the road anyway, and could they have been made from your home or office phone, where prices can drop to less than a dime? Fully 60 percent of cellular owners say they've used the cell phone to make calls they could otherwise have made from a regular phone, according to the Boston-based Yankee Group consulting firm.

• **Review before you renew.** Most contracts last a year or two, and cellular-phone rates will change considerably in that time. Before you automatically re-up for the same package you've had, consider how your use patterns have changed and whether a new plan may be more economical. If you discover that you are paying for service you aren't using, you might want to consider dropping back to a less expensive basic monthly package—or canceling your service altogether.

• **Beware of cellular theft.** Sophisticated high-tech thieves have made a lucrative business out of snatching the signals that carry unsuspecting cell-phone users' electronic serial numbers out of the air. Some $650-million in wireless service a year is stolen through such "cloning" of user IDs. Service providers don't make innocent victims pay for the fraudulent charges—though they could. You're still potentially on the hook for the misdeeds of others, since some service contracts hold subscribers liable for acts of fraud committed with their cell phones.

There are steps you can take to protect yourself from cellular thieves. When you're not using it, turn off your cell phone to reduce the chance that your signal can be intercepted. If you don't plan to make international calls, have your service provider disable that capability. Finally, if you suspect that you've been a victim of cell-phone fraud, call your carrier immediately by dialing 611.

Sure, having a cell phone can be much more convenient than hunting for a pay phone, and it can give you peace of mind. And yes, prices are falling; and fees for phone activation and early-termination are being waived, making it easier to justify getting wireless service. But don't rush into signing up for cellular simply because it's an appealing novelty. As with any costly addition you make to your budget, you should satisfy yourself first that this is a service you really need.

The price of cellular service, city by city

The table below shows the lowest-cost service rate plan offered in late November and early December by each carrier serving the 20 largest cellular markets in the U.S. Within each metro area, the plans are ranked by the monthly cost a typical consumer would pay based upon average personal use patterns. We computed the cost by adding to the basic monthly access charge additional per-minute airtime fees for a customer who was billed for an average of 42 minutes of airtime per month—17 minutes during peak time (the first number under the "Home" column), 23 minutes during off-peak time (the second number under "Home"), and two minutes while roaming in the lowest-cost roaming area. We applied any included minutes that come with the basic plan, though we excluded landline charges and assumed no long-distance calls were made. We added to the total bill any applicable administrative charges, and we did not allow for any temporary promotional discounts.

Service	Total monthly bill AVG. USER	Monthly access charge	Airtime minutes included	Charges per minute HOME	ROAM	Phone set-up fee	Fee to cancel early
ATLANTA							
AirTouch Safety	$30.65	$19.95	20	75/50¢	35¢	$0	$200
BellSouth Mobility Life Talk Plus	31.58	19.95	15	49/25	65	50	240
MCI One	51.13	49.95	45	35/23	59	10	200
BALTIMORE/WASHINGTON, D.C.							
Sprint Spectrum Talk 15 (PCS)	23.75[1]	15.00	15	31/31	50	0	0
Cellular One Peace of Mind	24.37	21.99	30	35/15	44	35	150
Bell Atlantic Nynex Talk Along Plus 20	27.17	19.99	20	30/30	59	30	0
MCI One	38.13	36.95	45	38/18	59	10	200
BOSTON							
Cellular One Assurance Choice Plus	28.15	19.95	20[2]	47/31	44	35	150
Bell Atlantic Nynex Talk Along	28.17	12.99	0	35/35	59	25	175
MCI One	31.13	29.95	45	45/30	59	10	200
CHICAGO							
Ameritech Convenience Pack	27.57	23.95	30[2]	39/23	50	35	200-300
PrimeCo ClearChoice.1 (PCS)	28.50	18.00	0	25/25	25	0	0
MCI One	31.13	29.95	45	34/20	59	10	200
Cellular One CellPak 15	33.33	24.95	15[3]	38/24	35	35	150
CLEVELAND							
GTE Wireless Talk & Go	32.93	16.95	0	35/35	99	42	17-200
AirTouch Clear Choice 25	33.14	26.99	25	49/31	75	40	150
MCI One	40.13	38.95	45	40/21	59	10	200
DALLAS/FORT WORTH							
AT&T Wireless Advantage 30 Analog	35.87	29.99	30	49/49	49	49	0-200
PrimeCo ClearChoice.1 (PCS)	38.34	27.00	0	27/27	27	0	0
Southwestern Bell 15	41.41[4]	26.95	15	48/50	50	49	150-165
MCI One	47.13	45.95	45	32/06	59	10	200
DENVER							
AT&T Wireless GoPhone	29.30	19.99	120[5]	49/10	49	40	0-200
AirTouch Casual Caller	33.41	29.95	30	48/25	48	40	150
MCI One	37.13	35.95	45	42/30	59	10	200
DETROIT							
Ameritech Convenience Pack	27.57	23.95	30[2]	39/23	50	35	200-300
AirTouch Association	29.38	19.99	0	26/13	99	0	0
MCI One	39.13	37.95	45	50/20	59	10	200
HOUSTON							
Southwestern Bell Easy One	32.00[4]	30.00	60[3]	50/28	50	49	150-165
GTE Wireless Freedom	34.97	29.99	20	50/20	49	50	25-300
Houston Cellular Security Plus	37.47	31.99	30	45/45	49	50	0
PrimeCo ClearChoice.1 (PCS)	40.50	30.00	0	25/25	25	0	0
MCI One	44.13	42.95	45	45/20	59	10	200
LOS ANGELES							
AirTouch Metro-Saver	36.23	19.95	10	49/49	79	50	150
L.A. Cellular Economy	41.49	34.99	20	79/26	65	50	100
MCI One	60.19	45.95	0	43/25	59	10	200

Service	Total monthly bill AVG. USER	Monthly access charge	Airtime minutes included	Charges per minute HOME	ROAM	Phone set-up fee	Fee to cancel early
MIAMI/FORT LAUDERDALE							
BellSouth Mobility 1996	$27.29	$19.96	15	49/25¢	30¢	$0	$240
AT&T Wireless Advantage 15 Digital	32.26	24.99	15	38/25	38	40	0-200
PrimeCo ClearChoice.1 (PCS)	35.50	25.00	0	25/25	25	0	0
MCI One	44.13	42.95	45	45/23	59	10	200
MILWAUKEE							
Ameritech Convenience Pack	27.57	23.95	30[2]	39/23	50	35	200-300
PrimeCo ClearChoice.1 (PCS)	28.50	18.00	0	25/25	25	0	0
Cellular One Security Plus	33.65	19.95	15	50/50	60	40	200
MCI One	36.13	34.95	45	27/18	59	10	200
MINNEAPOLIS/ST. PAUL							
AirTouch Casual Caller	33.35	29.95	30	45/25	45	40	150
AT&T Wireless Advantage 30 Digital	33.47	29.99	30	49/25	49	40	0-200
MCI One	37.13	35.95	45	35/29	59	10	200
NEW YORK CITY							
Omnipoint Basic (PCS)	30.45[6]	19.99	0	49/25	69	0	0
AT&T Wireless Advantage 30 Digital	32.19	24.99	30	60/60	60	0	0-200
Bell Atlantic Nynex EZ Max +30	36.27[7]	27.99	30	69/69	69	0	0
MCI One	38.13	36.95	45	65/45	59	10	200
PHILADELPHIA							
Bell Atlantic Nynex Express 30	27.87	24.99	30	37/17	59	0	0
Comcast Metrophone Personal Value	28.57	24.99	30	36/16	99	45	175
MCI One	34.13	32.95	45	35/15	59	10	200
PITTSBURGH							
AT&T Wireless Advantage 30 Digital	27.27	24.99	30	35/15	39	25	0-200
Bell Atlantic Nynex Phone in the Box	30.36	19.95	200[4]	49/19	99	0	0
SAN DIEGO							
GTE Wireless Safety Plus	27.56	19.95	30[4]	39/39	49	0	20-239
AirTouch $16.95	29.65	16.95	10	39/39	5	0	200
MCI One	47.13	45.95	40	40/19	59	10	200
SAN FRANCISCO/OAKLAND							
Cellular One Security	36.29	19.99	50	85/20	75	25	20-200
GTE Wireless Zone Saver	41.53	24.95	0	39/39	49	25	11-164
MCI One	52.93	49.95	30	45/18	59	10	200
SEATTLE							
AT&T Wireless GoPhone	29.30	19.99	120[4]	49/10	49	40	0-200
AirTouch Casual Caller	33.45	29.95	30	50/25	50	40	150
MCI One	36.13	34.95	45	40/15	59	10	200
ST. LOUIS							
Ameritech Convenience Pack	27.57	23.95	30[2]	39/23	50	35	200-300
Southwestern Bell ValuePak II	34.90[8]	29.95	120[9]	50/28	3	45	20-720

[1] First minute of all incoming calls is free. [2] One-half of the included minutes during peak hours; the other half during off-peak time. [3] One-third of included time during peak hours; two-thirds during off-peak time. [4] A $5 per month roaming fee applies in some areas. [5] All included minutes during off-peak time. [6] First $5 worth of airtime is free each month. [7] First minute of all incoming calls is free; discount of $8 per month during first year. [8] Extra $4.95 per month roaming fee not included. [9] Twenty minutes during peak hours; 100 during off-peak time.

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TRAC REPORT ADVISES CONSUMERS: DO YOUR HOMEWORK BEFORE PICKING CELLULAR SERVICE

CDMA Digital Standard Compares Best of New Technologies

Washington, DC -- Consumers need to do their homework before picking a cellular telephone service, according to a newly released study by the Telecommunications Research and Action Center (TRAC), a non-profit Washington based consumer group. TRAC, publisher of TeleTips(tm), has been educating consumers on the changes in the telephone and telecommunications industries since 1980. In this first-ever TRAC report on cellular service, the study reviews a number of new technologies and concludes that the technology called CDMA compares the best.

"Picking a cellular service used to be a choice between two available companies, each offering the same technology and essentially the same service. Today, a growing array of providers and technologies are available, and consumers need more information and sophistication to make smart choices," said Samuel A. Simon, counsel to TRAC. "It is not easy to make the best choice."

The TRAC report provides an in-depth explanation and evaluation of the four different cellular standards -- analog, TDMA, GSM and CDMA -- and evaluates each one based on voice quality, reliability, pricing plans, enhanced services and availability.

The report recommends consumers undertake a "self-assessment" to determine how they expect to use the phone and what services and features are likely to be most important. It then outlines the questions for consumers to ask, focusing on the new digital technologies.

"All cellular service is not the same," Simon said. "It's hard to know which newspaper ad is telling the truth when every company is claiming to offer the most state-of-the-art service on the largest network."

Of the four technologies, analog, GSM, TDMA and CDMA, the report states that CDMA came out ahead in almost every category that TRAC compared.

- more-

Among the recommendations in the report, are:

- Availability will matter a lot more to consumers who travel a great deal with their cellular phone, than to consumers who stick closer to home. Analog cellular service is currently available in most areas of the country, and the more advanced CDMA service is expected to be the most widely available digital service in the future. Of the other two digital services, GSM will be offered in most major cities but not in outlying areas, and TDMA is expected to be available except in some western states.

- Privacy is another area in which phone service providers compete. Because analog systems basically use radio transmissions which can be easily overheard, many wireless phone users want more security for their conversations. If consumers intend to use their wireless phone for emergencies, privacy probably won't matter much. But if security is an issue, any of the digital systems will give more protection than an analog system. GSM or TDMA, therefore, might be a good choice. CDMA, which was originally developed for military communications and actually scrambles each transmission, offers the highest level of security as well as the best overall sound quality.

The TRAC study developed a Quick Consumer Checklist to help buyers find their way through the maze of cellular claims and counter-claims.

Analog offers by far the greatest availability, but TRAC found that all three of the digital technologies provide significant advantages over analog when it comes to services. Among the digital services, CDMA performed the best in key categories such as signal security enhanced service, and reception, but the difference wasn't enough to outshine completely the other digital services. When it comes to power needs and reliability, however, CDMA was a clear winner. That's important, because it means that with CDMA consumers will spend less time recharging batteries and run much less of a risk that calls will be interrupted or dropped while traveling.

Until digital systems are more widely established, a dual-mode phone that switches back and forth between digital and analog cellular services may be the right choice for most consumers. But given CDMA's rapid expansion in the U.S. and its superior service quality, CDMA today looks to be the best bet for consumers over the long term.

In addition to the Quick Consumer Checklist, the report contains a listing of the major service providers and the technology they offer in the top markets, with phone numbers on how to reach each. The report also contains tips on how to pick the right pricing plan for your calling needs.

Copies of the report are available from TRAC, PO Box 27279, Washington, DC 20005, for $7.95, plus $1.50 for postage and handling.

Attached is a copy of the Executive Summary and the Quick Consumer Checklist.

# # #

Teletips Special Report™
A Consumer's Guide to the Changing World of Cellular Telephones

Index

ABOUT TRAC

The Telecommunications Research and Action Center (TRAC), is a non-profit organization devoted to educating and advocating for consumer interests in telecommunications. TRAC has a nearly thirty-year history, becoming the successor organization to the National Citizens Committee for Broadcasting in 1983, which was the successor organization to the National Citizens Committee for Public Broadcasting founded in 1967.

TRAC's focus has been on publishing consumer information about telephone and telecommunication products and services and advocating consumer interests in these important and growing services and technologies. TRAC publications have included *Reverse the Charges. How to Save Money on Your Phone Bill* (Pantheon, 1984) and *Phonewriting, a Consumer Guide to the New World of Electronic Information Services* (TRAC, 1986). TRAC also hosts a world wide web site (www.trac.org).

TeleTips™ is TRAC's quarterly newsletter that contains the only comprehensive rate and service comparison of long distance telephone companies. This special report represents the first effort to expand TRAC's focus into other products and services. It is the first in what we expect to be a series of reports on wireless and other new technologies.

Research for this report was undertaken by Geoff Mordock, staff associate for TRAC and Samuel A. Simon, Counsel to TRAC. Assistance was also provided by Consumers First and its President, Jim Conran, the former director of Consumer Affairs for the State of California.

Copies of this report are available from TRAC, PO Box 27279, Washington, DC 20005 for $7.95, plus $1.50 handling and postage for a total for $9.45.

EXECUTIVE SUMMARY

How do I pick the right cellular service? Which company and pricing plan is best for me? How do I decide which of the new technologies I should buy?

As more cellular companies enter the market, and as more and more choices develop, consumers need to know how to be smart shoppers. Unlike long distance service, where three or four companies provide identical service nationwide, cellular is more like local telephone and cable service with often widely varying services and technologies in different markets.

The following report, prepared by the Telecommunications Research and Action Center (TRAC), provides a consumer road map for making some of the most important decisions in picking a cellular service. The first half of the report looks at which questions to ask and the second half evaluates consumers' needs and how the various technologies stack-up.

Selecting the cellular phone service that best meets your needs is at a minimum a two-step process. First, you need to pick a service provider. Second, you need to select a pricing plan which best meets your needs. Just as it is true with long distance, there is no single answer to the question, "Which cellular phone service is the best?" The answer is, "it depends." How you select your provider and pricing plan depends on how you plan to use your cellular phone. If most of your calls will be local, issues like network compatibility and roaming charges will be less important than if you are someone who relies on their phone when they travel for work. The more sophisticated cellular phones now offer voice-mail, Caller-ID and other more sophisticated services which are invaluable if you need your phone for work, but might prove less necessary if you only use your cellular service in case of emergency.

Do a Self-Assessment

TRAC suggests that first you do a self-assessment. If you are a first time cellular user, talk to friends who have used cellular a long time. If you have service now and are looking to change or upgrade, you probably can answer these questions from your own experience.

- What is the primary reason you are purchasing a cellular phone? (e.g., personal safety, to keep in touch with children and relatives, business in town, business away from home, etc.) ?
- Will you use the phone when I am out-of-town or primarily in my local calling area?
- Will you spend more than 60 minutes a month on my cellular phone?
- Is the majority of the time you plan to spend on the phone during what is considered peak calling times? (7:00 a.m. -- 7:00 p.m.)
- Would you benefit from having a phone which provides more advanced features like voice-mail, Caller-ID, and the ability to send and receive text messages?

Questions to Ask:

Once you have completed the self-assessment you will be able to evaluate each of the cellular services and determine whether they meet your needs. Service questions to consider include the following:

1. Do you need an analog or digital service? What is the difference? What type of service is available? Are other services expected to be available soon?

2. **What is the difference between the digital technologies (CDMA, GSM, TDMA) and does it effect your decision?**

3. **Does the technology impact where and when you can use the phone. (That is, can you roam or use the phone outside you calling area easily?)**

4. **What type of technology will give you the best overall coverage or service?**

5. **What type of calling plan will best suit your needs, and does the technology effect that cost?**

How do the different cellular phone technologies compare?

The TRAC Consumer Report evaluated the different technologies when it comes to meeting the needs of consumers. TRAC looked at analog cellular, Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA) and Global System for Mobile (GSM).

Based on the categories discussed below, the report concludes that the emerging CDMA standard, and therefore the cellular systems that are based on it, come out significantly ahead overall.

TRAC based its conclusions on the following findings:

- **Service availability** -- Analog cellular service is the most widely available service at the present time. Digital networks are still being built-out. Of the digital networks in the US, CDMA is considered the predominant service.

- **Privacy and security** -- Digital service is better able to guarantee privacy and security than analog because it transmits signals in code. CDMA networks are the most secure because they transmit in code and the code is scrambled.

- **Enhanced service options** -- Digital service offers a more extensive package of services than analog cellular. Both GSM and CDMA services are competitive.

- **Power requirements** -- Digital technologies in general, require less power than analog cellular. CDMA requires the least amount of power of the digital services and provides the longest talk and stand-by time.

- **Voice quality** -- Because of its digitized signal, digital phones are able to provide better voice quality than analog. Of the digital technologies, CDMA is found to have the closest to land-line quality service.

- **Signal quality** -- Digital is better than analog and among the digital technologies CDMA comes out ahead because its broader range signal provides the best quality.

- **Reliability** -- Analog, GSM and TDMA all use hard hand-off when changing from one cell signal to another, sometimes resulting in an interruption in service. CDMA utilizes the soft hand-off which allows for signal overlap resulting in no interruption in transmission and therefore is more reliable.

- **Community Impact** -- The lower power demands of CDMA mean that fewer cell sites will need to be installed in a community. The advantage of fewer cell sites with broader coverage means less environmental and visual pollution. It also means that the systems can be built more quickly.

I. Introduction

Cellular telephones, once considered an extravagance, are now within reach for most of the general public. The bulky, suitcase-sized boxes that took up half a car trunk have evolved into tiny handsets that can slip into a shirt pocket. Sound quality is improving from the scratchy, cave-like echoing that many tolerated for years. And, the cost of cellular service is coming down, making it more affordable for everyone.

It seems as if everyone is picking up one of these phones. The Personal Communications Industry Association (PCIA) estimates that by 2001 the number of U.S. consumers using all types of wireless services will almost double from the number today. According to the Wall Street Journal, over 50 million people currently subscribe to cellular phone service in the U.S. (the U.S. is the largest market followed by Japan).[1] The number of users is expected to grow quickly over the next few years, with the largest increases coming in digital cellular services.

It used to be easy. Choosing a cellular provider was no different than choosing a long distance service. In long distance phone service, the primary factor has always been cost. Until recently, choosing cellular service meant choosing between two companies who offered similar services with competing purchase plans. The choices are no longer that simple. As the technology is improving, the choices are expanding, and knowing how to choose the right service is becoming more difficult. The last thing anyone wants to do is spend too much money on the wrong type of service.

Every day ads appear in the newspaper promoting the "best deal," the "largest network" and the most "state-of-the art" portable phone. How do you know if these ads are for real? The old adage "buyer beware" applies to the cellular market. It's nearly impossible to compare service based solely on rates because service from one provider to the next varies greatly. Because the technology is constantly changing, you need to do your homework to know what you're getting when a salesperson tells you he/or she can offer you the best service on the market.

In response to these challenges, the Telecommunications Research and Action Center (TRAC) has developed this report to help consumers select their cellular phone service. When it comes to cellular phone service, consumers want to know how to purchase the "best" cellular phone service on the market. While some consumers want the least expensive service, others who rely on their phones for business-related matters may view the highest quality of service as the best value. In this report, TRAC will help consumers define the "best" cellular service for

[1] *Wall Street Journal Reports*. September 11, 1997. Telecommunications Supplement. page 2.

them by looking at three critical factors: quality, coverage and cost. In order to do this effectively we will look at the technologies driving the market today, service coverage and purchase plan options. In the second half of the report we will evaluate how these factors influence customer choice and based on this information make recommendations on how to choose the right service. In future studies, TRAC will explore the specific issues of price, value added services and phone equipment.

II. Why is TRAC doing this study?

The Telecommunications Research and Action Center (TRAC)[2] has played the role of consumer watchdog for nearly three decades. It began its focus on telephone issues right before the breakup of AT&T in 1982. Since then, TRAC has concentrated on helping consumers make informed decisions about telecommunications issues, especially choosing the long distance company and calling plan that is best for them.

TRAC's newsletter, Tele-Tips™, provides consumers with a guide for comparing long distance telephone rates as well as tips on how consumers can save on their long distance calling. It is the only independent source of information on long distance calling plans that includes rate comparisons and plan descriptions.

With TRAC's history of consumer education on telecommunication products and services, a natural next step was to look closely at this fast growing new telephone service: wireless communications. Wireless technology is transforming communications. This report seeks to cut through the confusion by providing consumers with information about the varying technologies that directly affect quality, coverage and cost. In this study, TRAC hopes to alleviate much of the confusion surrounding wireless technology and assist consumers in making informed choices regarding service. In the following pages, TRAC develops a list of questions to ask when purchasing service, provides background information on the technology and an evaluation of how the different technologies impact consumers. At the end of this report we provide a quick consumer checklist to help determine the best wireless to suit your needs.

For more information about TRAC, or to receive additional copies of this report for $7.95 plus $1.50 shipping and handling, please contact: TRAC, P.O. Box 27279, Washington, DC, 20005, call (800) 344-TRAC, or visit our website at http://www.trac.org.

[2]Formerly the National Citizens Committee on Broadcasting.

III. Cellular Phone Service and Consumers.

Until recently, if a consumer was interested in purchasing a cellular phone, the choices were limited. But things have changed. Today consumers are faced with choosing from a number of different technologies, services, and pricing packages. TRAC's work in the area of long distance calling has focused on service plan options and how to select the least expensive plan for your needs. With cellular service, cost is not the only consideration and often not the most important. Because the options in the cellular market are rapidly changing, determining the best service requires that a number of different factors be taken into consideration.

Technology:

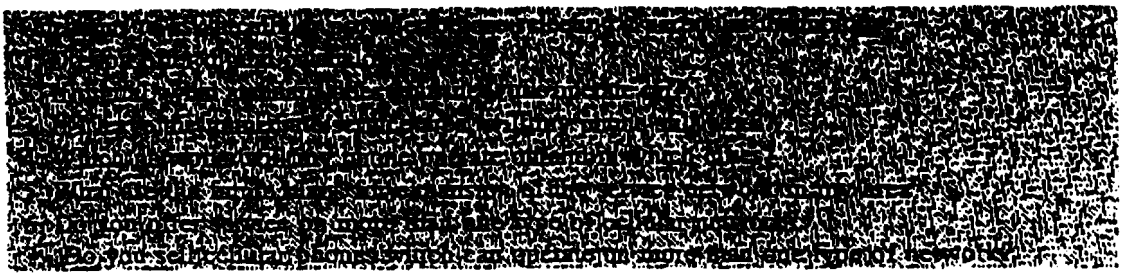
Even the term cellular service no longer means what it once did. Today, cellular phone service represents numerous technologies from which a customer can choose. One of the key distinctions in cellular technology is analog versus digital. Analog, the earliest type of cellular service in the U.S., is limited with little capacity to handle multiple functions. The other major category of service is digital, which includes TDMA, GSM and CDMA technologies. Unlike analog, digital phone technology can handle more sophisticated data-oriented services. But not all digital standards are the same. There are important differences which are addressed more specifically in the next section of this report.

Analog service is presently available virtually everywhere in the U.S., unlike digital networks which are still under construction but are quickly catching up. CDMA leads as the choice among the majority of service providers and will ultimately be available in more parts of the country than either TDMA or GSM.[3] For consumers, particularly those who use their cellular phones when they travel, availability of service is a key consideration.

Dual-mode phones have been designed to accommodate both digital and analog cellular service with the ability to switch back and forth during the course of a phone call. Also in the near future, multi-mode phones will allow you to switch back and forth between the different digital technologies like GSM and CDMA. When you purchase a phone, for use on a digital network, find out if it will operate on any other networks. In addition, before purchasing a phone, make sure you know what types of digital service are available in your area, as well as the types of service planned for the future.

Phones are another variable in the decision-making process. Cellular phones are designed to operate on specific networks offering a variety of technology-based features. Gaining consumer interest in the last few years has been the Personal Communications Service (PCS) phone, designed specifically to take advantage of the higher quality service and features available using digital technology.

[3] Richter, M.J. "CDMA Leads in the Cross Country Race." *CDMA Spectrum*. June 1997.



Price:

At the same time that the number of cellular technologies is growing, the number of pricing options offered by cellular telephone companies is also expanding. Typically, a contract for analog cellular service includes the cost of the phone. On the other hand, many of the new digital services require customers to purchase the phone up front. There are some exceptions to this rule, where the digital phone is included in the contract. Digital phones start as low as $99, with a mid-range price of $200 to $500. Because digital phones can be expensive and may not be interchangeable with other providers, selecting the right service type is important.

Selecting your calling plan wisely will ensure that you get the greatest calling value for the lowest price. Every cellular service, digital or analog, comes with a number of different options for purchasing service. Each plan caters to different types of customer usage patterns. Customers who plan to use their phone primarily for business purposes should consider a service plan that allows you to pay a flat fee up front in order to receive a deeply discounted per-minute rate. In general, the more time you plan to spend on the phone and the you are willing to commit to paying for up front, the more discounted your per minute charges are likely to be. But, if you only plan to use your phone in case of emergency, you should not agree to purchase 100 minutes per month just so you can receive a more discounted rate – you will still have to pay for all 100 minutes, even if you only use ten.

Customer purchase plans generally fall into three basic categories: high, medium and low usage. It is important to remember that cellular phone charges are usage sensitive, unlike basic land-line residential telephone service which charges a flat rate and provides unlimited local calling. The following scenarios are examples of types of service plans. It is important to understand that cost varies greatly from market to market based on type of service and competitiveness of the service area. The purpose of including these plans is to give you an understanding of the range of cost options:

Option I: A heavy user is defined as someone who will use approximately 1000 minutes a month. This type of user probably uses the phone for work, averaging 4-5 hours per week on their cellular phone. For 1000 minute plans you pay an up-front charge in the $200-$300 range. There is a per minute charge on additional minutes of use above 1,000 minutes of 20-30 cents for peak time calling and 10 cents for off-peak calls.[4] As the market becomes more competitive, you'll be able to find deals like 1500 minutes for $75 (now available in some markets).

Option II: A moderate user will typically use the phone for short, frequent calls. Service plans best suited for their needs will include the first 60-120 minutes per month for a monthly fee of

[4] (*Wall Street Journal Reports* Telecommunication Supplement September 11, 1997, Page R10).

$20-$40. The additional per minute charge for local calling will range from 30-50 cents for peak calling and as low as 10 cents for off-peak.[5]

Option III. A light user is typically someone who uses the phone only in an emergency. Some cellular providers allow customers to pay a low monthly rate with all calling time additional. Other low-end plans offer 30 minutes of calling time for a monthly fee ranging from $15-$30 a month with per minute charges ranging from 20-50 cents for peak usage.[6]

Other factors contributing to calling costs, not identified above, include roaming and long distance charges. Roaming charges are incurred when you leave your local calling area. Roaming outside of your calling area results in charges of 50 cents to $1 per minute on top of both the per minute usage cost and long distance charges.[7] It is important to remember that your local calling area for cellular service can be much bigger than for regular telephone service. As the cellular market becomes more competitive, many providers have begun offering service outside the local calling area with no additional roaming fees. TRAC believes this is a trend that is likely to continue.

In an effort to avoid long distance and roaming fees, business travelers have begun setting-up multiple phone numbers for their cellular service in multiple cities.

For example, if someone works out of both New York and Los Angeles, they can set-up what is called dual-NAM service with two phone numbers. The number in New York is provided by the local cellular provider and allows the business customer to make and receive calls in New York. The business customer also has a number programmed into the same phone which they use in Los Angeles. The Los Angeles number is local for that area and service is provided by the carrier local to Los Angeles.

[5]Ibid.
[6]Ibid.
[7]Ibid.

Roaming	Service provided by other networks for a user when they leave their local calling area. Rates are typically more expensive.
Long distance charges	Charges incurred while calling a phone number outside of the local network.
Peak and off-peak calling	The highest per minute rates are charged during peak hours (typically between 7am and 7pm, Monday through Friday). Off-peak is at all other times.

All of the charges described above have come down significantly in the last several years as competition in the cellular market has increased. Providers continue to come up with new pricing plans and promotions to attract new customers. One of the most popular service features that providers are making available on the newer digital plans is providing the first minute of incoming service for free. This is a real benefit for consumers who use their phones for short conversations.

Another example is Sprint PCS' recent announcement (9/15/97) of the Home Rate USA plan. Sprint PCS Home Rate USA allows customers to make or receive calls anywhere within the 65 Sprint PCS markets in operation nationwide at the home airtime rate, plus $4.95 per month. This enables customers who live in one city to travel to another city in the coverage area and be able to place local calls at their home airtime rate and not incur any long distance or additional roaming charges.[8] Waving the usage sensitive roaming fees is one way providers are attempting to attract new customers into the cellular market.

If you determine that you do not need to use your phone outside of the immediate calling area, it is not necessary to be concerned with network compatibility and roaming charges outside of the local area. Users who travel extensively will want to select a service that provides the best coverage. The very occasional user will want to select a service that has either limited or no minimum usage charges.

[8] "Sprint Sets First Nationwide Pricing Making Wireless Clearer Coast to Coast." Sprint Press Release, September 9, 1997.

Service:

The types of services available with your cellular phone will vary based on the technology, the provider, and the capabilities of the phone you purchase. Services available are determined in two ways: the technology or network your service is operating on and the type of phone you have. As the technology has improved, the number of "whiz-bangs" has continued to increase. Many of these more advanced features are currently being offered at no extra cost to consumers. But these features, if you use them, increase the amount of time you will spend on your phone, and as a result, the size of your monthly bill. Digital service, which includes GSM, TDMA and CDMA, offers features like voice-mail, Caller-ID, paging, three-way calling, call forwarding, text messaging and data and fax capability. More advanced applications using the text capability now available on many of the phones on the market include: receiving e-mail directly on your phone handset; browsing the Internet; and receiving news, weather and stock updates as they occur.

When purchasing a cellular phone, consider carefully which features you are most likely to use. Certain models offer programmable phone directories for up to 100 names, other less expensive phones with less memory might only store 25 names. Some phones include a data-port for connecting to a computer. If you plan to use your cellular phone in place of a regular phone line, this is a great feature, but also be aware that you are paying for this feature and for the usage time spent using this wireless service. Many consumers will find these features critical in the day-to-day performance of their jobs. Others will be interested in a more limited number of features, such as Caller-ID, which is a security feature that allows you to screen calls before answering them.

Many of the additional services are available by subscription, like text messaging. For an extra monthly fee, you can use your phone to send and receive messages. For those on the road this can be a very valuable service The information services delivered directly to your phone are also subscription-based. The more advanced digital network that you are on, the more sophisticated services you will be able to receive.

When shopping around for a service package, be sure to find out what is included in the cost of the service and the cost of additional features before signing up for the latest "whiz-bang."

Questions to ask a cellular provider before selecting a package of services:

1. Which services are included in the basic monthly package?
2. Which services are additional? Are these charges billed monthly? Are these services under

In this section TRAC has attempted to provide you with a primer and a list of questions to ask to guide the process and help you determine which service in your area is right for you. In the next section we explore more in depth the differences in the technologies currently on the market and how these differences in service impact consumers.

IV. What types of cellular technologies exist in the marketplace?

As demand for cellular phones has increased, the technology has responded. Today, you can choose not just between providers of similar services but also among providers of different technologies. Changes in technology over the last 10-15 years have come in a direct response to consumer demand and an increase in competition for new customers.

In the early days of cellular telephones the standard in the United States utilized analog cellular technology. Analog technology utilizes signals in waves much like the typical FM or AM radio. As cellular service began to decrease in price and increase in popularity, the capacity of the analog system increasingly became strained. With too many calls for the analog system to handle, cellular phone users often heard other conversations while on the line or failed to even get on the system. Theft of cellular service was also on the rise, and as a result, many customers began receiving charges on their telephone bill for calls that they did not place.[9]

In response to the limitations of analog, development of a new generation of cellular phones began in the mid-eighties. Engineers sought to eliminate many of the problems that people were having with their analog service by improving sound quality and security as well as expanding the number of service features. Digital technology became the clear solution.[10]

Two different digital technologies were developed that took somewhat different approaches to wireless communication. These are Time Division Multiple Access and Code Division Multiple Access.

TDMA "Time Division Multiple Access" divides the frequency into different time slots or digitally encoded packets. These packets are sent and received in line based on when the call began relative to other calls in the channel. The packets are always in the same place in time and the system creates the signal transmission.	CDMA "Code Division Multiple Access" is based on technology initially developed during World War II. CDMA assigns each calling party a code to be used for the duration of the call by any cell in the system that would handle the call. The signal is transmitted to the cell, which looks for that particular code, and all the other signals it receives. When that code is found the cell locks onto it. The signal that the cell has locked onto has the ability to use different frequencies throughout the duration of the call. Theoretically, there should be an infinite capacity for the number of calls to be placed because there are an infinite number of codes available.

Imagine a bus with fifty people participating in twenty-five different conversations -- each conversation in a different language. Each person can only understand the person they are talking to. Other conversations become background noise. This would be considered a CDMA bus. Conversely, on a TDMA bus, only one person can talk at a time because they have to speak loudly in order to be heard. Even if everyone spoke English, they would have to wait to

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[9]Criminals can monitor the airwaves for analog signals, copy the electronic serial number of a phone and create a 'cloned' phone. (Buckley, William M. "Stop, Thief!" *Wall Street Journal Reports*, September 11, 1997. Page R14.)

[10]Engineers determined that capacity for the next generation system should be at least ten times more than the AMPS network and also more secure. Developers realized that with analog cellular, calls are separated by using a different frequency. Each cell has a limited number of frequencies available and only a limited number of people can use a particular cell at a given time. They determined that through use of a digitized signal, the number of calls could be multiplied to increase capacity. Characteristics of digital technology make it much more difficult to tap users' calls. (Vitaliano, Frank. "How the Feds Blew It, Once Again." http://www.vxm.com/21R.62.html)

be able to speak for a certain period while others remained silent. CDMA operates on a lower power paradigm. This means that although there may be numerous conversations taking place, each person can clearly understand their own conversation.

Obviously, wireless technology operates much more quickly than do conversations on a bus. However, the way that the conversations take place on a CDMA bus and a TDMA bus describes the differences in how the technologies manage the limited amount of frequency available for wireless communications.

In the early 1990's, when TDMA first became available companies were anxious to offer customers the advantages of digital technology and immediately began deployment.

In the mid-1980's, Europe was attempting to create a common standard for digital cellular service which would work across borders. They eventually reached an agreement that produced the international standard known as Global System for Mobile (or GSM).[11] GSM utilizes the TDMA digital technology.

Shortly after TDMA was agreed upon as the U.S. digital standard, a company based in southern California announced the development of CDMA for commercial cellular use. Prior to the announcement, the technology had been deemed too "erratic," but the California company was able to demonstrate to numerous large carriers that CDMA was capable of providing a higher quality of service than GSM and the U.S. TDMA standards.[12]

In early 1996 a new standard of service was introduced, called Personal Communications Systems (PCS). PCS refers to the operating frequency which is set aside for more advanced wireless digital phone service. PCS provides a broad range of enhanced services, uses a smaller battery, and provides better reception. Some of these services include Caller-ID, simple messaging service (SMS), call waiting and call forwarding. Like PCS, CDMA phones are also designed to provide enhanced services, are lighter weight and provide longer talk-time.[13]

Initially, cellular providers offered service based on TDMA and GSM. However, in the last few years CDMA technology has effectively "caught up" to and has become the technology of choice for providers in the United States. Fifty-four percent of current license holders are CDMA. CDMA service expansion has happened because of its recognized benefits to the user. In a recent article in the Washington Post (9/22/97), staff writer Mike Mills observes that

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[11] At the same time that the United States was developing its digital standards, the European community was struggling with ways to resolve the problems it had encountered in their analog systems. Most countries in Europe had separate standards that were incompatible with others in neighboring countries. Europe was becoming one financial entity as borders became less significant, and the nations of Europe wanted to make sure that they agreed on a common standard for digital cellular service. (Sharrock, Stuart. "CDMA/TDMA: From Fists to Facts." http://www.ericsson.com/ Connexion/connexion3-93/techno.html) They reached an agreement, called the Memorandum of Understanding (MoU), to create an international standard known as GSM (Global System for Mobile). The standard enabled developers to design cellular phones that could operate worldwide. There is no copyright nor ownership of GSM, but use of certain parts in a GSM phone are restricted to members of the MoU. (http://WWW.GSMDATA.COM/mou.htm)

[12] Hardy, Quentin. "Cordless Confusion." *Wall Street Journal*. September 11, 1996. Page R20.

[13] One thing that is important for consumers to keep in mind is that the different types of technology utilized in digital transmission are not compatible. Furthermore, there is a distinction between TDMA and GSM, even though the latter is based on TDMA technology. TDMA is the term used when referring to the IS-54 and IS-136 standards, primarily used by AT&T Wireless and BellSouth, while GSM refers to the standard signed at the MoU. Also note that there is a difference between frequencies in which wireless phones communicate. PCS systems are limited to a certain frequency, therefore a PCS phone will not be able to have access in areas where analog service is the only type deployed. (http://www.pcsdata.com/pcsintro.htm). Currently, these incompatibility issues are being addressed in the development of new phones that can switch between digital standards and frequencies. (http://www.pcsdata.com/roaming.htm)

Sprint Corporation, which inherited GSM when it invested in the company Sprint Spectrum, has rejected GSM outside of the Washington-Baltimore area because the company now believes that CDMA is a better technology. Sprint Corporation is now in the process of building its national network, Sprint PCS, based on CDMA.

The discussion has been heated as to which standard is better, and in this report TRAC attempts to clear up some of the confusion. You need to choose your service based on how and where you plan to use your cellular phone. In the next section, we look at the technology's impact on the consumer.

V. Evaluation of technologies and their impact on consumers.

In the previous sections we discussed the basic differences in the technologies and questions to ask when shopping for service. In this section we look more carefully at how services implicit in the different technologies directly impact the consumer. By evaluating reliability, availability, privacy and security, enhanced services, power requirements and impact on the community, we can begin to draw some conclusions about the type of services that best suit customer needs.

Availability. What types of services are available in my area?

Analog cellular service has been around for some time now and is available in most areas of the country. Digital networks are in the process of being built with service available primarily in major cities and are expected to be widely available within the next few years.

Of the digital services in the U.S., CDMA is anticipated to become the most widely available.[14] It is anticipated that there will be nearly 1 million CDMA users in the U.S. by the end of the year. Availability of GSM and TDMA in the next few years will also increase, but not to the levels projected for CDMA. Consumers who are interested in using a digital phone will eventually find that CDMA-based service will be available in just about any area of the country, both urban and rural. GSM service will be offered in most major cities -- but not outlying areas, and TDMA will be available in all but the western areas of the country.

Digital phones operate on many different frequencies throughout the world which are not necessarily compatible. Phones are being developed that can switch between the different frequencies and standards, eliminating many of the compatibility problems between services and service areas.[15] Currently, CDMA dual-mode and dual-band dual-mode phones offer the ability to switch from digital to analog service when they enter an area that does not provide CDMA coverage. TDMA and GSM phone manufacturers have also developed phones that will be able to operate on a dual and multi-mode basis. GSM, as mentioned earlier in the paper, already provides service that allows Europeans to use their phones in the U.S. Without full deployment of a national network that allows for operation of a particular digital cellular technology -- CDMA, GSM, or TDMA -- switching between digital and analog, for the time being, remains an important feature for the consumer who travels and wishes to use a digital phone.[16]

Some argue that if you want a standard you can use to travel across the country into many different areas, then you should acquire a handset and service that utilizes the most popular

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[14]According to a report produced by Dataquest, Inc., the number of U.S. subscribers using CDMA is expected to surpass TDMA-based technologies by 1999. Although analog cellular is currently deployed across the nation, the number of those subscribers using analog service will decline rapidly as digital service is provided in more areas. GSM subscribership is not expected to grow as quickly as CDMA and TDMA (IS-136), and will still be behind analog as the standard of choice well into the next century. Dataquest, Inc. expects that by the year 2001, CDMA carriers will have 36% of the U.S. market compared to 32% for TDMA, 5% for GSM and 26% for analog. Current levels are 4% for CDMA, 9% for TDMA, 2% for GSM and 85% for analog (*Wall Street Journal Reports* Telecommunication Supplement, September 11, 1997, Page R20).

[15]The advent of "dual-mode" and "multi-mode" phones that provide the ability to switch between different frequencies and standards will eliminate the challenge of roaming in areas not served by your provider. (Emmett, Ariclle. "Wonders of the World Phone." *America's Network*. November 15, 1996; and "A Study in Wireless Contrasts." *America's Network*. May 1, 1997.)

[16]Phones already exist that allow a user to utilize frequencies in both the 800 MHz and 1900 MHz PCS band levels. Other phones already exist that allow users to access GSM in both the 900 and 1800 frequencies. Still more phones let consumers switch between CDMA and AMPS. One of the primary arguments made by GSM providers is that it is compatible with GSM systems around the world. The only compatibility is the vocoder and the SIM chip, not the frequency used in transmission. (http://www.pcsdata.com/roaming.htm)